PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

VOL. IV. 1860–61. No. 54.

Monday, 17*th December* 1860.

PROFESSOR KELLAND, Vice-President, in the Chair.

The following Communications were read:—

1. Contributions to the Natural History of Volcanic Phenomena and Products in Iceland. By W. Lauder Lindsay, M.D., F.L.S. Communicated by Professor Balfour.

These contributions are part of the results of the author's visit to Iceland in June 1860, and will be found embodied in his Paper "On the Eruption, in May 1860, of the Kötlugjá Volcano, Iceland," in the "Edinburgh New Philosophical Journal" for January 1861, page 6, with a map (Plate II.), "Illustrative of the Physical Geography of that part of the South of Iceland in which Kötlugjá is situated." The contributions in question may be classified under the following heads:—

(1.) *An Account of the Kötlugjá Volcano.*

- *a.* Its topography and geology.
- *b.* Peculiarities of its crater: the Icelandic *gjás* in relation thereto.
- *c.* Chronological record of its eruptions, which have been as follows:—

1st Eruption, A.D.	894	Interval since previous Eruption.
2d	934	40 years.
3d	1245	311 ”
4th	1262	17 ”
5th	1311	49 ”
6th	1416	105 ”
7th	1580	164 ”
8th	1612	32 ”
9th	1625	13 ”
10th	1660	35 ”
11th	1721	61 ”
12th	1727	6 ”
13th	1755	28 ”
14th	1823	68 ”
15th	1860	37 ”

d. Details of the Eruption of May 1860.

e. Main peculiarity of the eruptions of Kötlugjá—*water and ice-floods.*

f. Physical and geological character of the surrounding country, as determined by the phenomena and products of the eruptions of Kötlugjá.

(2.) *Notes on Icelandic Geology and Mineralogy.*

a. Palagonite and the palagonitic rocks; especially those of Seljadalr, Fossvogr, and the coast between Reykjavik and Havnafiord.

b. Basalts.

c. Obsidians.

d. Pumice-tuffs.

(3.) *Chemical Analyses:* of—

a. The waters of the Laugarnes hot-spring near Reykjavik.

b. Muds and other deposits from the same spring.

c. Muds and other deposits from the hot-springs of Krisuvik.

d. Sulphur-muds from Krisuvik.

e. Havnafiordite [of Forchhammer] from Havnafiord near Reykjavik.

f. Palagonite-tuffs from the coast between Reykjavik and Havnafiord.

g. Basalts and Trachytes from the Island of Videy near Reykjavik.

The large amount of *Silica* found in the water of the Laugarnes hot-springs is confirmatory of all former published analyses of the waters of the Geysers and other hot-springs in Iceland. The percentage of *Sulphur* in the Krisuvik sulphur-muds is *unusually high*, being from 96·39 to 98·20 of pure sulphur, while the crude Sicilian sulphurs generally contain not above 80 to 90 per cent.

(4.) *Hints to Naturalists anent Natural History Expeditions to Iceland.*

2. On the Pediculi infesting the Different Races of Man.

By Andrew Murray.

The object of this paper was to determine whether the pediculi infesting the different races of man were of the same or of distinct species, and thereby to ascertain whether any inference could be drawn therefrom, bearing upon the disputed question of the unity of the human species.

The author had obtained specimens of pediculi taken from sixteen or eighteen different races of mankind, and had discovered certain minute differences which appeared to be constant in the different races. These differences, however, did not appear so different in particulars, or marked in degree, as to justify their being considered different species.

The following Donations were received :—

Transactions of the Historic Society of Lancashire and Cheshire. Vol. XII. 1860. 8vo.—*From the Society.*

Transactions of the Medico-Chirurgical Society. Vol. XLIII. 8vo. —*From the Society.*

Atti del R. Istituto Lombardo di Scienze, Lettere ed Arti. Fasc. 17–20. 4to.—*From the Institute.*

Quarterly Journal of Geological Society. Vol. XVI., Part 4.—*From the Society.*

Transactions of the Academy of St Louis. 1859. 8vo.—*From the Academy.*

Journal of the Proceedings of the Linnean Society. Vol. V., No. 18.—*From the Society.*

Comptes Rendus Hebdomadaires des Seânces de l'Academie des Sciences. Tom. LI., Nos. 22, 23.—*From the Academy.*

Memoranda on Vegetation. By John Hunter, F.R.S. London, 1860. 4to.—*From the Royal College of Surgeons, London.*

Catalogue of Plants and Invertebrata. 1860. 4to.—*From the same.*

Catalogue of Fossil Plants. 1855. 4to.—*From the same.*

Catalogue of Vertebrata in Spirit. 1859. 4to.—*From the same.*

Observations on Geology. By John Hunter, F.R.S. 1859. 4to.—*From the same.*

Catalogue of Fossil Reptilia and Pisces. 1854. 4to.—*From the same.*

Catalogue of the Histological Series. Vol. II. 1855. 4to.—*From the same.*

Journal of Geological Society of Dublin. Vol. VIII., Part 3.—*From the Society.*

Journal of Statistical Society of London. Vol. XXIII., Part 4.—*From the Society.*

Monthly Notices of Astronomical Society. Vol. XXI., No. 1.—*From the Society.*

A Treatise on Physiology and Anatomy in the Chinese Language. By Benjamin Hobson, M.B.—*From the Author.*

Treatise on Midwifery and Diseases of Infants in Chinese. By B. Hobson, M.B.—*From the same.*

Treatise on the Science and Art of Western Surgery in the Chinese Language. By B. Hobson, M.B.—*From the same.*

Treatises on Medicine and Natural Philosophy in the Chinese Language. By B. Hobson, M.B.—*From the same.*

A Medical Vocabulary in English and Chinese. By B. Hobson, M.B. 1858.—*From the same.*

Transactions of Botanical Society, Edinburgh, 1860.—*From the Society.*

Monday, 7th January 1861.

PROFESSOR CHRISTISON, V.P., in the Chair.

The following Communications were read:—

1. Note on Hydrated Sulphuric Acid. By Dr Lyon Playfair, C.B.

It is well known that hydrated sulphuric acid loses sulphuric anhydrid on heating, and that its specific gravity decreases in consequence. It is of some practical importance to know the exact circumstances under which this takes place, and the following experiments may prove useful in this respect. Sometimes, in distilling and subsequently evaporating sulphuric acid, I obtained a hydrate of sp. gr. 1·848, and at other times not exceeding 1·842. To explain these differences I took—

1. Monohydrated sulphuric acid, having the sp. gr. 1·848, and containing by alcametrical testing 81·62 per cent. of anhydrous acid, and buried the retort containing it in hot sand, and distilled. The distillate now contained only 80·12 anhydrous acid, and had a sp. gr. of 1·840 at 60° Fahr. It had lost in distillation about 1½ per cent of anhydrid.

2. The weak acid thus got by distillation was exposed to a temperature near to, but not exceeding, 554° Fahr., for forty minutes. On cooling, its alcametrical strength was 81·615 of anhydrid, and its specific gravity 1·84798.

3. A portion of the first acid, having the strength 81·62 of anhydrid, and the specific gravity 1·848, was boiled violently for two hours. On testing, it was now found to contain only 80·01 of anhydrid and to have a specific gravity of 1·838.

4. The weak acid got in the last experiment was kept for one hour at a temperature of 550° Fahr. The concentrated acid thus got gave 81·62 anhydrid and a specific gravity of 1·84792.

From these experiments, it follows, notwithstanding Marignac's researches, that there is a real monohydrated sulphuric acid obtainable by evaporation, and that its specific gravity is in reality as high as 1·848, which is the number formerly given in books; but that this hydrate is decomposed between the temperature of 550° Fahr. and the boiling point of oil of vitriol.

2. Note respecting Ampère's Experiment for showing the Repulsion of a Rectilinear Electrical Current on itself. By Principal Forbes, LL.D., &c.

The experiment referred to was performed in 1823 by Ampère in the presence of Mr A. De la Rive. It is intended to show that if one portion of a rectilinear conductor is made moveable, it will be repelled from the portions which form its continuation. The arrangement employed was a copper wire-float in a double trough of mercury, which cannot easily be explained without a figure.

This experiment, though quoted by most writers on electricity, is understood to be one not easily repeated. Indeed, the author has not found an indication of its ever having been repeated with success. The author conceiving that perhaps this repulsion described by Ampère might assist in explaining the vibrations of rocking bodies through which an electrical current passes (as described in a communication by him to this Society in January 1859), devised another, and, as he conceives, a more delicate method of testing the supposed repulsion of a rectilinear current on itself. This he accomplished by connecting the two poles of a battery by means of a piece of copper-wire shaped like a horse-shoe, and laid upon one extremity of a slender wooden lever suspended by a fine platinum wire, after the manner of a torsion balance. Yet, on the establishment of the circuit through the bent wire, so far was there from being any repulsive force tending to separate the torsion rod from the battery poles, that the connecting horse-shoe was sensibly and even powerfully attracted to the poles, both while the current lasted, and for some time after.

This experiment seems to throw a doubt upon Ampère's conclusion. The author believes that his mode of experimenting is not only much more delicate than that of Ampère, but also that it avoids sources of ambiguity present in the other.

3. Fragmentary Notes on the Generative Organs of some Cartilaginous Fishes. By John Davy, M.D., F.R.S. Lond. and Edin., &c.

These notes, it is stated by the author, were made at different times and places, as opportunity favoured, and are offered as a contribution to a difficult branch of Ichthyology.

The generative organs of nine different species are described, with more or less minuteness of detail. The species are *Squalus squatina*, *S. galeus*, *S. acanthias*, *S. carcharias*, *S. centrina*, *S. canicula*, *Scyllium melanostomum*, *Raia aquila*, and *R. oxyrhynchus*.

From the observations made, these species would appear to differ in some essential points as regards the reproductive process; some, as the *S. squatina*, being viviparous,—their ova developed or hatched in the uterine cavity; others, as *S. acanthias* and *S. carcarias*, being oviporous, their ova included in a shell with a white, yet developed in the same cavity, the presence of a shell constituting the difference comparing them with the preceding; others, as *R. aquila*, and *S. canicula*, being oviparous, their eggs experiencing no embryonic development in the oviducts, and hatched after exclusion in the sea.

Respecting the anal appendages, the characteristic of the male cartilaginous fish, the opinion the author is most inclined to adopt is, that they are not claspers, but rather organs of intromission; preferring this latter—the old view of their use, as noticed by Aristotle—to the former, which is the more recently entertained one, from considering their structure and certain facts which have come to his knowledge.

Concerning the branchial filaments, which have commonly been held to be mainly subservient to the supplying with air the blood of the embryo, he thinks they may have another use also, that of aiding the growth of the parts to which they belong. Their early absorption, and being sometimes found in other regions of the embryo than the branchia, are brought forward as circumstances favourable to this idea.

The following Gentlemen were admitted Ordinary Fellows:—

William A. F. Browne, F.R.C.S.E.
Rev. Thomas Brown.
Robert Edmund Scoresby-Jackson, M.D., F.R.C.S.E.
James M'Bain, M.D., R.N.
Professor P. Guthrie Tait.

The following Donations to the Library were received:—

Transactions of Royal Scottish Society of Arts, Vol. V., Part 4. 8vo.—*From the Society.*

Proceedings of Royal Society of London, Vol. X., No. 41.—*From the Society.*

Proceedings of the Horticultural Society of London, Vol. I. Nos. 18, 19. 8vo.—*From the Society.*

Jahresbericht der Chemie, von H. Kopp u. H. Will. Giessen, 1860. 8vo.—*From the Authors.*

Proceedings of the Academy of Natural Sciences of Philadelphia, pp. 81–284. 8vo.—*From the Academy.*

Etudes et Expériences Synthétiques sur le Metamorphisme, par M. Daubrée. Paris. 1860. 4to.—*From the Author.*

Observations Meteorologiques faites à Nijné Taguilsk. Année 1857. 8vo.

Sitzungsberichte der Königl. Bayer. Akademie de Wissenschaften zu Munich. 1860. Part 2.—*From the Academy.*

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt. 1860. No. 1. 8vo.—*From the Society.*

Bulletin de la Société de Géographie. Quatrième Série. Tome XIX. 1860.—*From the Society.*

Memorie dell'Accademia delle Scienze dell'Istituto di Bologna. Vols. VIII., IX., X., Part 1. 4to.—*From the Institute.*

Rendiconto delle sessioni dell'Accademia delle Scienze dell'Istituto di Bologna. 1858–59. 8vo.—*From the Society.*

Mémoires de l'Académie des Sciences de l'Institut Imperial de France. Tome XXX. 4to.—*From the Institute.*

The Canadian Journal, November 1860. 8vo.—*From the Canadian Institute.*

Comptes Rendus hebdomadaires des Séances de l'Académie des Sciences. Tome LI., Nos. 24–26.

Norsk Forfatter-Lexikon 1814–56 af Jens E. Kraft. Parts 1–5. Christiania, 1857. 8vo.—*From the Royal University of Christiania.*

Index Scholarum in Universitate Fredericiana. Christiania, 1860. 4to.—*From the same.*

De vi logicæ rationis in describenda philosophiæ historia ad Eduardum Zellerum epistola quam scripsit M. J. Monrad.—*From the same.*

Forhandlinger i Videnskabs-Selskabet i Christiania, aar 1859. 8vo. —*From the same.*

Radcliffe Catalogue of Stars for 1845. Oxford, 1860. 8vo.—*From the Radcliffe Trustees.*

Catalogus van de Boekerij der Kon. Akad. van Wetenschappen. Amsterdam, 1860. 8vo.—*From the same.*

Verslagen en Mededeelingen des Kon. Akad. van Wetenschappen. Amsterdam, 1840. 8vo.—*From the same.*

Jaarboek van de Kon. Akad. van Wetensehappen. Voor, 1859. 8vo.—*From the same.*

Verslag over den Paalworm. 1860. 8vo.—*From the same.*

Transactions of the Bombay Geographical Society, Vol. XV. 8vo. —*From the Society.*

The Assurance Magazine and Journal of the Institute of Actuaries. January 1861.—*From the Institute.*

Journal of Agriculture and Transactions of the Highland and Agricultural Society of Scotland, No. 71, New Series.—*From the Society.*

Monday, 21*st January* 1861.

The Very Rev. DEAN RAMSAY, V.P., in the Chair.

The following Communications were read:—

1. On a Method of taking Vapour Densities at Low Temperatures. By Dr Lyon Playfair, C.B., F.R.S., and J. A. Wanklyn, F.R.S.E.

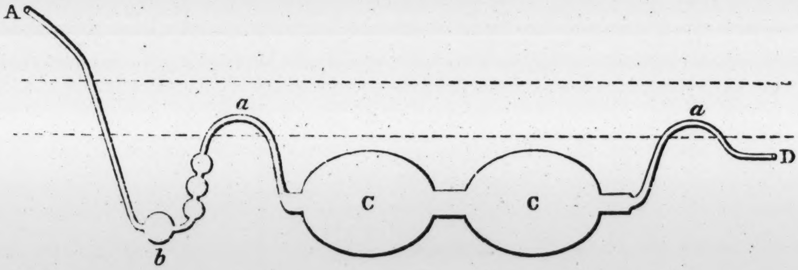
The authors refer to Regnault's experiments, which have shown that aqueous vapour in the atmosphere has the same vapour density at ordinary temperatures as aqueous vapour above 100° C.; and they bring forward fresh experiments upon alcohol and ether to show that when mixed with hydrogen these vapors preserve their normal density at 20° or 30° C. below the boiling points of the liquids, and infer generally that vapours, when partially saturating a permanent gas, retain their normal densities at low temperatures.

From their researches the authors deduce the consequence—remarkable, but quite in harmony with theory, that permanent gases have the property of rendering vapour truly gaseous. Stated in more precise terms, the proposition maintained by the authors is, "The presence of a permanent gas affects a vapour, so that its expansion-coefficient at temperatures near its point of liquefaction tends to approximate to its expansion-coefficient at the highest temperatures."

The authors anticipate that admixture with a permanent gas may serve as a kind of re-agent to distinguish between cases of unusually high expansion-coefficient in a vapour, and cases where chemical alteration takes place. It will also be possible, by the employment of a permanent gas, to obtain vapour-densities of compounds which will not bear boiling without undergoing decomposition.

In experimenting upon substances which may be heated above the boiling point, the authors employ Gay Lussac's process for taking the specific gravity of vapours. A slight modification is, however, necessary. Previous to the introduction of the bulb containing the weighed substance, dry hydrogen is introduced into the graduated tube and measured with all the precautions belonging to a gas analysis. It will be obvious that in the subsequent calculation the volume of hydrogen corrected at standard temperature and pressure must be subtracted from the volume of mixed gas and vapour, also corrected at standard temperature and pressure.

When the substance will not bear heating to its boiling point, the authors employ a process resembling that of Dumas in principle, but differing very widely from it in detail. Dumas' flask with drawn-out neck is replaced by two bulbs, together of about 300 cub. cent. capacity, joined by a neck, and terminating on either side in a narrow tube. One of the narrow tubes has some very small dilatations blown upon it (*b*), the other is merely bent (D). (See the drawing.) The apparatus, whose weight should not exceed 70 grm., is weighed in dry air, then placed in a bath, being secured by a retort-holder grasping the neck joining the large bulbs C and C. The end A, projecting over the one side of the bath, is made to communicate with a hydrogen apparatus ; the end D passes through a hole in the opposite side of the bath, which is plugged up watertight by means of putty. Dry hydrogen is transmitted through the whole arrangement, and escapes at D through a long narrow tube joined to it by a caoutchouc connecter.



The bath is next filled with warm water until the bends *a* and *a* are covered. The connection with the hydrogen apparatus is then for a moment interrupted, to allow of the introduction of a small quantity of the substance at A. The substance, which should not more than half-fill the small bulb *b*, is partially vaporised in the stream of hydrogen, and in that state passes into the part CC. All the while, the temperature of the bath is kept uniform throughout by constant stirring, and made to rise very slowly. When within a few degrees of the temperature at which the determination is to be made, the current of hydrogen is almost stopped, so that the bulbs C and C may contain less vapour than will fully saturate the gas at the temperature of sealing. The water of the bath is then made to subside, by opening a large tap placed near the bottom. The bends *a* and *a* are thus exposed, the bulbs CC remaining covered. Immediately the current of hydrogen having been stopped, the flame is applied at *aa*, so as to seal the apparatus hermetically. The temperature of the bath, as well as the height of the barometer, must now be observed. After being cleaned, the apparatus (which now consists of three portions, viz., the portion CC hermetically sealed and the two ends *b* and D) must be weighed.

The capacity of the apparatus is found by filling it completely with water and weighing; but previously to this operation the volume of hydrogen enclosed at the time of sealing must be found. On breaking one extremity under water, the water will rise in the bulbs, and, after a while, will have absorbed all of the vapour, but will leave the hydrogen. The bulbs must then be lifted out of the water, without altering their temperature, and, with the water that has entered, weighed. The difference between the latter weighing and the weight of the bulbs quite full of water gives the weight in grammes, which expresses in cubic centimeters the volume of hydrogen enclosed; the pressure is the height of the barometer minus the column of water which had entered the bulbs; the temperature is that of the water.

An example of a determination of the vapour density of alcohol at 30° C. below its boiling point is subjoined :—

Height of the barometer (at 0° C.), .	763·09 m.m
Temperature of the balance case, . .	7·5° C.
Weight of apparatus in dry air, . .	69·959 grm.
Temperature at time of sealing, . .	48° C.
Weight of apparatus + hydrogen + vapour,	69·5275 grm.
Weight of apparatus + water (at 5.2° C.)	191·76 grm.
Weight of apparatus filled with water, .	545·36 grm.
Height of water column, . . .	122 m.m.

From which is deduced :—

	Volumes corrected at 0° C. and 760 m.m. pressure. Cubic centimeters.		Grm.
Hydrogen + vapour,	406·43	weighing	0.1695
Hydrogen,	341·27	„	0·0306
	65·16		0·1389

Therefore, 65·16 cub. c. of alcohol vapour weigh ·1389 grm.
but 65·16 cub. c. of air weigh ·0843 grm.

$$\text{Vapour density of alcohol} = \frac{\cdot 1389}{\cdot 0843} = 1\cdot 648$$

The authors have extended their experiments to acetic acid and other substances. At low temperatures the vapour-density of acetic acid approximates to 4·00, no matter how much hydrogen be employed. At higher temperatures, an approximation to 2·00 is obtained, but without heating so high as Cahours found necessary.

The authors are continuing these researches.

2. Memoir of Sir Thomas Makdougall Brisbane. By Alexander Bryson.

The following Donations were laid on the Table:—

Journal of Proceedings of the Linnean Society—Supplement to Vol. V.—Botany. 8vo.—*From the Society.*

Bulletin de la Société des Sciences Naturelles de Neuchatel. Tome, V., Pt. 2. 1860. 8vo.—*From the Society.*

Quarterly Report of the Meteorological Society of Scotland, for the quarter ending 30th September 1860.—*From the Society.*

Monthly Notices of the Royal Astronomical Society. Vol. XXI. No. 2.—*From the Society.*

Proceedings of the Royal Society of London, Vol. XI., No. 42. 8vo.—*From the Society.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Tome LII., No. 1.—*From the Academy.*

Monthly Return of Births, Deaths, and Marriages in Scotland. December 1860.—*From the Registrar-General.*

Catalogue of the Edinburgh Medical Society's Library. 2 vols., 1837 and 1845. 8vo.—*From the Society.*

Monday, 4th February 1861.

Principal FORBES, V.P., in the Chair.

The following communications were read :—

1. Notes on the Snow Crystals observed during the late Frost. By Professor Allman.

On the 26th of December last, about half-past 11 A.M., a light snow shower fell in Edinburgh, and lasted about half an hour. The air was at the time still, and the sky overcast with a thin haze, while the thermometer stood at many degrees below the freezing point. The appearance of the snow was very remarkable. It fell in loose open flakes, and lay upon the surrounding objects in little masses like tufts of exquisitely white, soft and light down.

Remembering the descriptions of the crystals of snow in high arctic regions, and during intense frost even in our own latitudes, as given by Scoresby, Glaisher and others, I was desirous of determining how far the structure of the snow now falling corresponded with the accounts of these observers. I accordingly, with the view of rendering their composition more apparent by contrast with a dark surface, collected a few of the falling flakes upon a sheet of blackened pasteboard, when, even to the unassisted eye, a structure of marvellous beauty was at once revealed. The white down-like snow-flake was now seen to be an aggregate of symmetrical and transparent ice stars, many of them more than a quarter of an inch in diameter. When examined under the compound microscope with the aid of a two-inch object-glass, their beauty became still further enhanced, and it was then seen that every star was itself composed of a multitude of transparent crystals, in some cases tabular, in some acicular, and all grouped in obedience to a definite law, so as in their wonderful assemblages to give rise to shapes of exquisite symmetry,—shapes, too, of almost infinite variety ; the kaleidoscope, in its magical transformations, is not more rich in forms,—yet all pervaded by an unbroken unity, for their type had been already fixed ; and even in their most sportive mood, they could be seen to be under the control of a definite number and a definite quantity—the number 6 and the angle of 60° determining their form and limiting their variations.

Among the various figures which I observed on the occasion referred to, we may perhaps select, as the archetypal combination, a 6-rayed star (fig. 1), having for its centre or nucleus a tabular crystal in the form of a regular hexagon, each of whose angles supports one of the six rays of the star. Each of these rays would seem to be a very much elongated hexagonal prism, and every one of them gives off from each side, and in the common plane of the figure, secondary arms, which spring from it with a pinnate arrangement, and at an angle of 60°. These secondary arms in the figure under consideration are also elongated hexagonal prisms; in the greater number of instances, however (figs. 2–5), the secondary arms are wedge-shaped, and probably the result of more complex conditions than those under which the type form is produced. The axis of symmetry of each of these wedge-shaped arms is inclined to the ray at an angle of 60°, but I cannot say at what angle the sides of the arms are inclined to one another. The central hexagon in the figure, from which the sketch was taken, was marked with elegant concentric striæ.

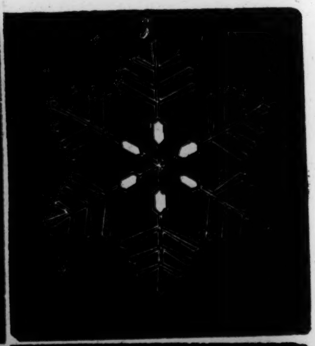
It is here worth noting, that the figure I have assumed as the type consists exclusively (if we except the termination of the arms) of a combination of the two limiting forms of the Rhombohedron *m* R; namely, that in which *m* becomes practically 0, and that in which it becomes infinite, producing in the former case the tabular crystal 0R, which constitutes the centre of the figure, and in the latter case the prismatic crystals ∞ R, which constitute the rays and their branches.

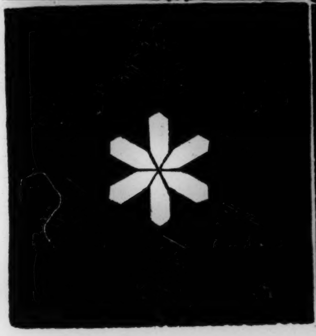
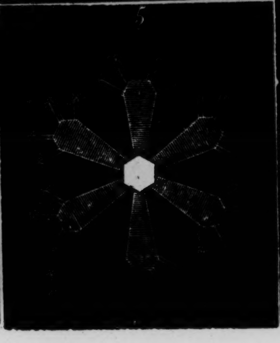
Assuming then the form now described as the type, there would seem to be but little difficulty in deducing from it most of the peculiarities presented by the other figures which I have had an opportunity of observing. In fig. 2, the central hexagon has disappeared, and the rays meet at a point in the centre of the star.

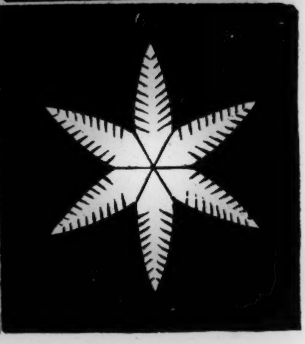
In fig. 3, a tabular hexagonal crystal is developed diagonally in the course of each ray at a uniform distance from the centre, and in the common plane of the star.

Fig. 4 is easily derived from fig. 3; for in order to produce it, we have only to suppose all the six hexagons to be simultaneously prolonged in the direction of the ray, until they meet in the centre of the figure, when, in consequence of mutual and symmetrical interference, they will terminate in an angle of 60°, or of half the proper angle of the hexagon, thus forming *maccles* whose plane of union is inclined to the principal axis of the ray at an angle of 30°.

In fig. 5 we have a central hexagon, carrying symmetrically on each of its angles a wedge-shaped five-sided table, which thus takes the place of the acicular ray in fig. 1. Three of the sides of this table appear to be those of the regular hexagon, while the remaining two sides would, if continued, meet at an angle which I have not been able to measure, somewhere within the central hexagon. From each of the free angles of the wedge-shaped ray, a little hexagonal prism is developed.





The simply pinnate rays of fig. 2 occasionally become doubly pinnate. I have found even trebly pinnate varieties.

I also noticed a form (fig. 6) which is not exactly traceable to the *type*, and which I am inclined to view rather as an abnormal condition induced upon one of the other forms by the coalescence, or imperfect development, of the secondary arms. It consisted of a six-rayed star, in which the rays, instead of being prismatic or wedge-shaped, were lanceolate, the curved boundaries thus bringing this modification almost entirely into the type of organic form. The edges of the rays were marked with pinnate serrations or striæ.

In this last form we are strongly reminded of the beautiful stellate figures, like six-petalled flowers, which have been recently described by Professor Tyndal as being developed within a block of ice, when the rays of the sun are concentrated on a point in the interior of it by a burning lens.

Besides the forms now described, the snow which fell on the 26th contained many others, any one of which would well repay the trouble of drawing, though no figure can give an adequate idea of the elegance of the actual object, in which the most beautifully symmetrical flowers, and elaborately divided fern leaves, are repeated with that marvellous fidelity with which inorganic nature occasionally imitates the forms of organisation when the formative forces are directed by an undeviating symmetry.

But the ordinary snow of our latitude is not thus constituted. We may seek in vain in the snow as it usually falls with us for the beautiful stellate crystalline groups now described. Why is this? There are doubtless needed, for the perfect development of the ice crystals in the freezing cloud which is about to descend in the form of snow, several conditions, as yet but partially understood. Of these, it is posssible that a temperature considerably below the freezing point may be one, and a stillness in the higher regions of the atmosphere, where the snow is formed, another. It is exceedingly probable, as has been ingeniously suggested by Fr. Vogel,* in explanation of the phenomena of hail, that if the atmosphere be perfectly still, the particles of visible vapour constituting the cloud may be cooled far below the freezing point without freezing; and if in this state a crystal of ice be precipitated into the cloud from some higher elevation, or the stratum of cold vapour be agitated by sudden exposure to some atmospheric current, the balance between the forces of cohesion and adhesion will be destroyed, and the whole cloud will instantly shoot into beautiful ice-crystals, and will fall towards the earth as stellate snow; for the peculiar constitution of the visible vapour is such, that unimpeded action will be permitted to the forces of crystallisation, and no mechanical obstacle will be offered to the perfectly symmetrical development of the crystalline groups.

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* See Müller's Kosmische Physik, p. 421.

If the temperature of the inferior strata of the atmosphere be sufficiently low, the snow-crystals will reach the earth unaltered; but if, in their descent, they happen to pass through strata whose temperature is above the freezing point, they will—if they be not actually converted into rain—lose the sharpness and beauty of their outline, while partial thawing, followed, at the surfaces of contact, by the singular phenomenon of regelation, which, as has been shown by Faraday, may take place in an atmosphere considerably above the freezing point, will probably contribute to their irregular conglomeration into an ordinary snow-flake, contrasting as this does so strongly with the light, open, down-like flake produced under circumstances favourable to the perfect development and persistence of the crystals.

On the 27th, the snow which had fallen during the preceding day was still lying on the ground, and, with the view of continuing my observations, I again placed some of it under the microscope. I now, however, found that the crystals had lost all their beauty, and no longer presented the sharpness of outline and symmetry of form which had so forcibly struck me the day before. And yet, during the interval, the thermometer had never risen to the freezing point, nor had the snow been exposed to the direct action of the sun. The change of form thus undergone by the crystals appears to me to admit of but one explanation, and is evidently due to the partial dissipation of the crystal by evaporation, thus affording an interesting example of the evaporability of ice at temperatures considerably below the freezing point.

While on this subject, I may as well mention another fact illustrative of the same phenomenon.

It will be remembered that on more than one occasion during the severe frost a dense fog settled over the city, and was afterwards condensed and frozen on the surrounding objects, covering everything on which it lay, but especially the naked branches of the trees, with the most exquisite frostwork. This beautiful phenomenon, however, was but of short duration; for in less than twenty-four hours, though the temperature continued all the while below the freezing point, and the air free from wind, which might have shaken the frozen particles from the trees, yet not a trace of the frostwork remained.

To form, then, a true conception of the constitution of a snow-flake produced under the conditions which prevailed during the late intense frost, we have only to imagine thousands of stellate groups, such as those just described, entangled together by their complex arms into little loose flocculent masses. The peculiar light down-like character of the snow which fell on the 26th of December is thus easily understood.

On the 7th of January, between 4 and 5 P.M., the sky overcast, and the thermometer standing considerably below the freezing point, Edinburgh was visited by another snow shower. On this occasion the shower was of a very peculiar kind, for the stellate groups of crystals, instead of being aggregated into flakes, as in the shower of the 26th December, were for the most part isolated and distinct, so that the whole atmosphere was filled with separate ice-stars in inconceivable multitudes, whirling through the air, and drifting past one another in mazy paths which no eye could follow, so endless were their intersections, and inextricable their labyrinths; the wonderful ice-drift heaping itself up like white sand on the surrounding objects, but when projected against dark surfaces, revealing itself in all the unrivalled symmetry and beauty of its starry atoms. The chief difference between the present snow shower and that which fell on the 26th December, consisted in the segregation of its crystalline particles. There was a brisk breeze stirring at the time, in the lower regions of the atmosphere, and this was doubtless the invisible analyst that broke up the snow-flakes into their component elements, and flung them in stars and flowers to the earth.

The following Note from Mr Stephens to Dr Balfour was also read:—

REDBRAE COTTAGE, *14th January* 1861.

MY DEAR SIR,—In December 1859, I was visiting Sir Robert Peel at Drayton Manor, in Staffordshire; and while there, a very heavy hoar-frost occurred for nearly two days,—every tree and shrub and the grass was fringed with most beautiful silver filagree. When walking along the shrubbery in the forenoon, I was led, from the remarkable exuberance of the hoar-frost, to examine it more minutely than by a casual glance; and to my surprise and delight, I perceived that the crystals presented quite a different arrangement on different bushes of evergreens. This there was no doubt of, as I could easily discern the difference in the arrangement of the crystals by the help of a large magnifying glass which I always carry with me when I go from home. I regret I did not take a sketch of the different arrangement of the crystals; but not being prepared for such a proceeding, and being no hand at sketching, I contented myself with looking from one bush to another. And while thus engaged for some time, I thought I made an interesting discovery—namely, that while different bushes presented a different form of crystallisation, the same sort of bush presented the same form of crystals. This discovery interested me very much—for discovery I deemed it, not having observed any mention of such a thing in any book on meteorology I have seen. Thus, Portugal laurels, laurel bays, laurustinas, different sorts of Arbor-vitæ, the yew, some of the new pines, presented different forms of crystals, but the same kind of plant had the same form of crystal. This I made sure of by repeated observation in different parts of the shrubbery; and more than that, the size of the crystals was about in proportion to the size of the leaves of the evergreens. Thus, the crystals in the Portugal laurel, laurel bays, and larger leaved kinds of evergreens, were larger than on the leaves of the laurustina, and these latter larger than in those of the yew and Arbor-vitæ. The crystals, moreover, were not spread over the surface of the leaves, but only along their margins; and the leaves above, that were exposed fully to the air, had the crystals—those within the bush, or under shelter of the leaves above them, were free of all hoar-frost. I may mention that the sun was obscured the first day by a frost-fog; the second day was clear, but the crystals retained their form where the sun did not strike; and on the following morning, the whole fairy scene had disappeared. Tall grasses and sedges by the side of a lake presented different crystals, but the same kind of plant similar forms. The naked branches of trees presented similar results. . . . .

I am, &c.,

HENRY STEPHENS.

2. The Bifilar Magnetometer: its Errors and Corrections. By John Allan Broun, F.R.S., Director of the Trevandrum Observatory. Communicated by Professor Tait.

The bifilar magnetometer has been employed in all the magnetical observations, with an exception or two; its theory has been stated generally, but no careful examination of the errors of the instrument, as deduced from experience, has been published. The author has attempted to supply this deficiency.

In the theory of the instrument, the proper elasticity of the wires has been neglected, as of little importance. The author shows that the wires receive a twist in the adjustment, which puts the upper suspension-points into a different plane from the lower ones; that the force so produced enters into the equation of equilibrium in a marked manner. The theoretical conclusion is verified by experiments on the torsion force of the wires. But as a proper twist generally exists, the angle of torsion, as well as the time of vibration, are unfitted for an accurate determination of the coefficient which relates the same divisions to the unit. Different methods of determining the unit coefficient are noted, and the results of experiments are given.

The greatest source of error in connection with the observations is that due to varying temperature. It has been usual to suppose that the temperature affected only the magnetic moment of the magnet, and the length of the wires and the interval separating them. It is shown that it affects also the coefficient of elasticity of the wires. Experiments made hourly during many days, with an unmagnetic weight suspended by two wires, are cited, to show that the varying temperature produces effects on the position which might be expected from theoretical considerations.

A method proposed by the author in 1842, and described in the "Edinburgh Transactions" in 1845 (vol. xvi. p. 74), by which a temperature coefficient is found, including all the effects, is then noticed, and the results obtained from discussions of all the observations of the bifilars in the colonial observatories (including the observations of nearly twenty-eight years), are given. From these it appears that the coefficients usually employed are on the average nearly one-half too great, and in some instances they are the double of the true coefficients.

The author concludes by a notice of the accidental errors to which the instrument is liable.

3. On the Horizontal Force of the Earth's Magnetism. By John Allan Broun, F.R.S., Director of the Observatory of the Rajah of Travancore. Communicated by Professor Tait.

The conclusions of this paper are derived from observations made at Makerstoun in Scotland; Toronto, Canada; Trevandrum, Travancore, and Singapore, East Indies; St Helena, the Cape of Good Hope, Hobarton, Van Dieman's Island, &c. The author has corrected and discussed all the observations published made in the colonial observatories.

The observations have been found affected by different errors, and frequently the series have been broken. An attempt has been made to correct these series; and, in general, to render the series as near the truth as possible. The grounds for all these corrections are given in an appendix.*

The results obtained may be summed up as follows:—

Secular Variation and Mean Yearly Force.

1*st*, The secular change of the horizontal intensity followed the same law, and had the same value very nearly, at Makerstoun in Scotland, and at Hobarton, Van Dieman's Island, the units being the absolute force at the respective places.

2*d*, The law of change is, however, not linear, but had a maximum at both places, at the mean epoch, January 1844, and a minimum about July 1847.

3*d*, At other stations the secular change has not always the same value as at Makerstoun and Hobarton, nor has it always the same duration.

4*th*, The yearly mean force was sometimes an increase at *all* the stations, and it is concluded that the yearly mean intensity of the magnetism of the whole earth is not a constant quantity.

5*th*, The secular change is probably a result of two causes—one dependent on the position of the earth's magnetic poles, the other dependent on their varying intensity.

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* Some observations examined were found valueless, on account of errors which could not be corrected; and in one case the requisite data for accurate correction were wanting.

Annual Period.

6*th*, The annual period confirmed by each year's observation, and by groups of years at Makerstoun and Hobarton, at Trevandrum, Singapore, Toronto, &c., is, that the horizontal intensity of the earth's magnetism is a maximum near the solstice and a minimum near the equinoxes. The equations for Makerstoun and Hobarton, according to the function of sines, for the group of years July 1844 to June 1848, are as follows:—

Makerstoun, $y = 5{\cdot}20 + 1{\cdot}66 \sin. (\theta + 161^\circ\, 47') + 2{\cdot}98 \sin. (2\theta + 129^\circ\, 34') + 0{\cdot}80 \sin. (3\theta + 31^\circ\, 42')$

Hobarton, $y = 4{\cdot}90 + 1{\cdot}64 \sin. (\theta + 217^\circ\, 38') + 2{\cdot}54 \sin. (2\theta + 129^\circ\, 11') + 0{\cdot}45 \sin. (3\theta + 172^\circ\, 46')$

Where $\theta = 0$ July 16, and the unit is one 100,000th of the horizontal intensity at each place.

7*th*, The epochs for the total curve deduced from these equations are—

	Makerstoun.	Hobarton.
Principal Minimum . .	October 1.	September 16.
„ Maximum, . .	December 22.	January 1.
„ Minimum, . .	March 6·5.	April 4.
„ Maximum, . .	June 30·5.	June 17.

8*th*, The law is confirmed by the observations at Munich in 1843–5, made with a unifilar instrument where deflecting magnets are used, and where the probable error due to the varying torsion of the silk suspension-fibres, and the small directive force of the suspended magnet, renders such a confirmation the more remarkable.

9*th*, The law is also confirmed by a discussion of observations of *absolute* horizontal intensity made at Toronto, the Cape of Good Hope, and Hobarton. The results of these observations are shown to be faulty, from the inaccuracy of the temperature coefficients employed; but the error due to this cause will appear in the term A_1 sin $(\theta + C_1)$ of the equation of sines, while the term A_2 sin $(2\,\theta + C_2)$ on which the double maximum and minimum depend, may be expected to be free from the error, and to show the law. The observations are discussed, and the term obtained in each case differs little from the mean of the terms from the Makerstoun and Hobarton bifilars, or—

$$2{\cdot}76 \sin (2\,\theta + 129^\circ.)$$

10*th*, The usual method of taking monthly means gives only twelve points for the whole year, each point corresponding to the middle of a calendar month, the means being supposed to vary regularly from point to point. The author has combined two years' observations for four places (Makerstoun, Trevandrum, Singapore, and Hobarton), so as to have four weekly means corresponding to each day in the year (Sundays excepted), and the most minute variations of these four weekly means for any one place are followed by those for the others. This fact is, however, only a corrollary to the following:—

Daily Mean Variations.

11*th*, The daily mean horizontal force at all places on the surface of the globe increases simultaneously or diminishes simultaneously. The amount of increase or of diminution has generally the same value (the horizontal force at each place being the unit), so that the increase or diminution is in proportion to the absolute value of the horizontal intensity at the respective places. The variations from this result can be traced to disturbances which seem sometimes to have a greater effect on the daily mean near the poles than near the equator.

12*th*, In order to follow the variations of the daily mean in shorter intervals than one day, the author has combined the observations so that daily means are obtained corresponding for their middle points to each hour of the twenty-four, instead of to one hour only. This has been done for a period of six weeks only, including one of the 26-27 day periods (see 13*th*) for the four places above mentioned (10*th*), and for Toronto and the Cape of Good Hope. The results are that the turning-points frequently agree to the same hour, though they also frequently differ to several hours; the greatest variation being connected with large disturbances in high latitudes. Marked turning-points, maxima or minima at one place, are sometimes shown only as minor turning-points; at others, and in the cases of some large disturbances, while the turning-point (say the commencing diminution of force) occurs at the same instant on all meridians, the rate or velocity of change is not the same in all—the rate probably depending on the hour of the day at which the disturbance has its maximum value at different places, the local law of disturbance being superposed on the general law of mean daily variation.

13*th*, It follows from these results, that the daily mean absolute intensity of the whole earth is not a constant quantity, but that it increases as a whole, and diminishes as a whole, from day to day.

14*th*, In the examination of the usual daily means for the years 1842–48 (though the years 1844–45 only are considered in this paper), it appears that there is a period of about 26·2 days on the average, which is felt equally (within the limits of errors of coefficients) and simultaneously at all the stations. This period was remarked by the author in his discussion of the Makerstoun Observations for 1844–45; it was attributed at that time to the action of the moon, and the law obtained connected with its synodical revolution. The author gives grounds to show that it is probably due to the sun. The identity of the movement at all stations at the same time, whatever may be the position of the moon, would of itself disprove the connection of our satellite as the cause of this period. An examination of a larger series of observations than that considered in this paper will show that the minimum frequently takes place at full moon, as well as at new moon.

15*th*, The author has avoided theoretical speculations in his paper, but he believes that the moon acts as a secondary cause, the large disturbances occurring most frequently near full moon. This fact, he thinks, hypothetically, may be connected with an electric fluid emanating from the sun, acted on by the planets, and drawn towards the earth most powerfully when the moon is in opposition. This action does not prevent, though it occasionally masks, the period due to the rotation of the sun itself, and the unequal electrical tension of its different sides—this difference being also probably connected with the solar spots. It is obvious that should the moon and planets act in the way supposed, the period due to the sun's rotation will appear to vary within certain limits, independently of the supposition that the sun's side of greatest tension is variable. Such an hypothesis would connect the secular variations with the electrical tension of the sun, and the periods of the planets. The author proposes to consider this question more at large hereafter, in a discussion of all the observations from 1840 up to the present time. He concludes by noticing the appearance of a period of about sixty to seventy hours in the daily mean variation.

4. Notice of an Instrument intended for the Measurement of Small Variations of Gravity. By John Allan Broun. Communicated by Professor Tait.

If we suspend a weight by two wires, and turn the weight suspended from its position of repose through an angle v by means of any force, the wires will no longer be vertical, and the weight will be lifted from its lowest position by a gravity equal to $l \sin i \tan i$ where l is the length of a wire and i is the small angle which it makes with the vertical. If we represent the force which keeps the weight W from its position of rest by f, and the intervals of the wires above and below by a and b, it is known, as in the case of the bifilar magnetometer, that the equation of equilibrium is—

$$f = \mathrm{W} \frac{ab}{l \cos i} . \sin v .$$

If we suppose the force f to be constant, and that only W and v vary by small amounts, then we find

$$\frac{\Delta \mathrm{W}}{\mathrm{W}} = -\cot v \, \Delta v .$$

The ratio to the whole weight of any variation, produced by any such cause as recession from the centre of the earth, whether by climbing a mountain or by changing position on the terrestrial spheroid, will thus be determined by observations of v and its variation. Small variations of W may be determined if we give v a value approaching to 90°, and if we can observe small variations of v.

The following plan is being adopted for the purpose suggested. The weight, a cubic inch of lead, is suspended by two fine platinum wires; the cube has mirrors on three of its vertical faces, two of which are capable of adjustment so as to make an angle of about 86° with the middle mirror: below the cube a fine hair spring, like that of a watch balance, but of platinum (so as not to rust), is attached by one extremity to a central pin fixed below into the weight; the other extremity is fixed (when the weight hangs freely and the spring exerts no force) to a hollow cylinder which turns freely round the pin as a centre. In this ring another mirror is fixed parallel to the middle mirror of the weight, and immediately below and in front of it. A telescope is so placed that when the spring has no action on the weight, the central divisions of two scales (divided on glass) are seen reflected, one from the middle mirror of the weight, the other from the ring mirror at the same time. Such scales have been employed by the author with small sextant telescopes, for which one division equalled twenty seconds, and two seconds could be estimated.

Let us now suppose the two mirrors parallel, the spring exerting no action on the weight, and that the middle mirror faces the south. The observation commences by turning the ring (say directly) through an exact revolution, which is known by the mirror showing exactly the same scale division. The eastern mirror, which makes an angle of about 86° with the middle mirror, will now bring the scale into the field of the telescope (if the proper precautions have been taken by the maker, in adjusting the force of the spring and the interval of the wires to each other); and the scale division being made, the exact angle (v) through which the weight has been turned will be obtained. The ring should now be returned to its first position, and the observation repeated by turning the ring in the opposite direction (say retrograde) through a revolution.

It is evident that it is not necessary that the ring should be turned exactly through a revolution; it may be turned exactly a few degrees more or less by means of the scale, so that observations may be made with different values of v, and therefore with greater or less delicacy. Thus, as may easily be shown, when $v = 86^\circ$, a variation in height of ten feet will be equivalent to a variation of three seconds; when $v = 88^\circ$, the variation of three seconds will be produced by a rise of about five feet only. In proceeding from the poles to the equator, v should vary from 84° to 90° nearly.

The precautions taken to render the instrument portable, so as to keep the spring and wires with constant forces, the means of correcting for the effect of temperature, &c., need not be noticed till the completion of the instrument.

It should be pointed out as a great advantage of the instrument, that a large weight is not required, since it is the ratio of the variation of weight to the whole weight which is shown.

5. On the Law of Growth in Woody Circles of Exogenous Trees, as indicated by the Examination of a Single Specimen. By Principal Forbes.

The following Gentlemen were elected Ordinary Fellows:—

John Muir, D.C.L., Oxon.
William Turner, M.B.
W. Lauder Lindsay, M.D., F.L.S.

The following Donations to the Library were received:—

Proceedings of the Royal Horticultural Society. Vol. I., No. 20. —*From the Society.*

The Eruption, in May 1860, of the Kötlugjá Volcano, Iceland. By W. Lauder Lindsay, M.D., F.L.S. 8vo.—*From the Author.*

London University Calendar. 1861. 8vo.—*From the University.*

The Polar Regions. By Sir John Richardson, LL.D. Edinburgh, 1861. 8vo.—*From the Author.*

Illustrations of the Genus Carex. By Francis Boott, M.D. London, 1858. 2 vols. folio.—*From the Author.*

Bombay Magnetical and Meteorological Observations. 1858. Folio.—*From the Indian Government.*

Monday, 18th February 1861.

The Hon. LORD NEAVES, V.P., in the Chair.

The following Communications were read:—

1. On the Embryology of Asteracanthion Violaceus (Linn. Sp.) By Wyville Thomson, LL.D., F.R.S.E., M.R.I.A., F.G.S., &c., Professor of Natural History in Queen's College, Belfast.

Early in December of the present winter, several specimens of *Asteracanthion violaceus* (L.) were procured, in the peculiar pregnant condition described by Sars. The disk was raised into a hump, and the rays drawn together at the base, to form the "marsupium" for the protection of the young. All the eggs or embryos in a single marsupium were at the same stage of development. In the least advanced, the eggs were undergoing the later stages of yelk-segmentation, while in others this process had been completed. In other individuals the embryos were partially or fully formed. A specimen, in whose pouch the mass of eggs were least advanced, was placed in a jar of sea-water, and the embryos were examined from day to day.

Segmentation appears to take place in this species in the way usual in the class, and involves the whole yelk. After segmentation, the embryonic mass is at first spherical, finely granular, and still invested by the vitelline membrane. This membrane soon disappears, and within a few hours the embryo seems perfectly homogeneous, regularly oval, and of a delicate flesh-colour. No trace of cilia could be detected at this stage on the surface. Four or five hours later, the oval form is still more marked; one end has become slightly dilated, and towards this end there is an accumulation of the granular substance. The whole embryo is now invested by a delicate structureless gelatinous layer, which is thinner and less apparent towards the narrower end of the oval. At the broader end it invests a dark consistent granular layer, of considerable thickness, formed of oil globules, and compound-granular masses and cells, which lines a central cavity, filled with a clearer granular semi-liquid, in which there are traces of molecular or ciliary motion.

The transparent investment of the narrow end now protrudes three tubular processes, two long and narrow, turned in one direction, and the third, shorter and thicker, turned in the opposite direction. Between these tubes in the centre there is a raised whitish imperforate tubercle. Each tube is dilated at the extremity into a slightly opaque rounded bulb, which at length takes the form of a sucker, undistinguishable from the ambulacral suckers of the young star-fish.

The granular fluid of the embryo still passes freely into the tubes through their wide common base.

This common base now contracts and lengthens; and this narrower portion of the clavate embryo is separated by a distinct line of demarcation from the broader mass, which gradually assumes a rounded and then a pentagonal form. The embryo during these changes increases rapidly in size. The peduncle, with its tubular appendages, now assumes its definite and final form—a wide transparent contractile tube, prolonged inferiorly into three, or sometimes four, wide tubular branches, terminated by suckers. The contents of the peduncle and tube-feet consist of a clear colourless fluid, in which chyle corpuscles, of the usual form, move and circulate with the motion peculiar to such particles in the vessels of the echinoderms. The embryo adheres by the suckers at the ends of the tubes to a foreign body, and moves along by the contraction and expansion of the three feet. The peduncle is attached to the lower surface of the rudimentary star-fish, slightly excentrically and midway between two of the rays. The star-fish, though now only about once and a-half the size of the peduncle, has asserted distinctly its echinoderm character. The pentagonal form is distinctly recognisable, and plates of the characteristic calcified areolar tissue have begun to appear in the external layer, both on the upper and the under surface. These plates assume a definite arrangement; and shortly a depression appears in the *centre* of the oral surface of the star-fish, and gradually deepens till it communicates with the central cavity of the body, forming the permanent mouth. Round the mouth a delicate tube forms an annular elevation, passing at one point under or into the base of the peduncle—the œsophageal circular vessel of the ambulacral system; and from this ring five delicate straight tubes pass to the ends of the rays, each tube flanked on either side by a row of rudimentary ambulacral suckers.

Up to this period, the general granular contents of the embryo could be forced by slight pressure into the tubes of the peduncle. Now, however, the attachment of the peduncle to the embryo gradually contracts, and at length it distinctly coalesces with, and becomes attached to, the annular ambulacral ring. Pressure applied to the peduncle no longer injects the general cavity of the star-fish; it only dilates its ambulacral vascular system. The true ambulacral system of the embryo now develops rapidly, assuming its proper locomotive and respiratory functions, and the peduncle withers—the sucking feet first breaking off, and the body of the peduncle disappearing finally, as a gradually contracting sac hanging to the ambulacral ring, midway between two of the rays. At the point of disappearance no scar is afterwards perceptible.

It would appear from the foregoing observations, that the first step in the development of this form of echinoderm embryo is the differentiation of a portion of the yolk into an investing layer of structureless "Sarcode;" that the layer gradually increases in thickness; and that finally, from one part of its surface, a branched peduncular process is produced, as an extension of the same transparent structureless material. The branches of this organ are terminated by suckers, and serve, among other functions, as organs of locomotion. When fully formed, they are undistinguishable in structure and function from the ambulacral feet of the star-fish; a fluid undistinguishable from the chylaqueous fluid of the ambulacral system moves in them with the same characteristic motion. The peduncle is closed externally, no communication, except by transudation, existing between its cavity and the surrounding medium. At first it communicates with the general cavity of the embryo, but afterwards it becomes connected with, and part of, the ambulacral circulating system. When the ambulacral vessels and suckers of the young star-fish become fully developed, this provisional vascular tuft disappears, leaving no apparent scar. In the species described, the peduncle is not connected in any way with the madreporic tubercle, which is not developed till long after its disappearance, and then on the opposite surface of the body.

The peduncular appendage seems to be essentially a provisional development of the ambulacral vascular system, and to be functionally analogous to the omphalo-mesenteric and umbilical vessels of the vertebrate groups, endowed, however, with a greater amount of versatility of function, corresponding to that of the peculiar vascular system of which it forms a part, and to a great degree dependent upon the peculiar vital properties of the substance entering into its structure.

2. Some Observations on the Albino. By John Davy, M.D., F.R.S. Lond. and Ed., &c.

The subjects of these observations were five individuals—four females, one male—all natives of Ceylon, of its south-east salubrious coast, and the children of coloured parents.

They are described by the author as well made, as having good health, and, though all coming under the denomination of Albinos, on account of their unusual fairness, yet as varying in degree, the lightest having red eyes and almost white hair; the less light, blue eyes and light-brown hair, with a complexion that in this country would be considered merely that of a pure blonde.

It would appear that the Albino in Ceylon, contrary to what has been asserted, is not held in contempt, but rather in respect, in accordance with the feeling of the people towards persons of high caste, who are almost invariably of a lighter hue than the more laborious and exposed low caste.

A speculation of the Singalese is mentioned relative to the white races, viz., that they are the descendants of Albinos, and, *ab origine*, merely an accidental variety.

The author seems to think that analogy is not unfavourable to this hypothesis, keeping in mind how great is the variety of colour, and its gradations from light to dark, amongst Europeans, and, in the instance of our domesticated animals, how colour is hereditary; and also on the ground that the sun's rays have a greater darkening effect on persons of brown skin than on those of fair; and that the former, especially the darkest—the blacks—are better able to resist malaria and the effects of tropical climates than the whites, and have thereby a better chance of escaping disease, and a premature death and extinction of race.

3. Note on the Bisulphide of Iodine. By Frederick Guthrie.

An examination of the action of certain compound halogens towards some of the olefines (the results of which I hope shortly to lay before this Society), has led me to consider incidentally the preparation of some of the compound halogens in the pure state.

Of compound halogens, while the constitution of none is more invariable and definite than that of the bisulphide of chlorine, the bisulphide of iodine can scarcely be said to have been prepared, despite the so strong analogy between chlorine and iodine.

That iodine combines with sulphur is well known; that such combination is attended by the liberation of heat, is equally well established. And since homogeneous mixtures of the two may be prepared in all proportions, it is clear that a substance having the percentage composition of the bisulphide of iodine may be formed. Bodies so formed have little or no title to the name of chemical compounds.

If we remember, on the one hand, the fact which I have abundantly proved elsewhere, that an equivalent of bisulphide of chlorine functions as two equivalents of chlorine, or, as some chemists would express it, that the molecule of bisulphide of chlorine is biatomic; and if we further remember, that at least two equivalents of chlorine or of zinc are required to recompose iodide of ethyl according to the equations—

$$(1.)^* \quad C_4H_5\,I + 2\,Cl = C_4H_5Cl + I\,Cl$$

$$(2.) \quad C_4H_5\,I + 2\,Zn = C_4H_5\,Zn + Zn\,I,$$

we must be prepared to anticipate the analogous recomposition—

$$(3.) \quad C_4H_5I + S_2Cl = C_4H_5Cl + S_2I.$$

This the more, since in the case of certain compound groups, such as Na Sn, we find

$$(4.) \quad C_4H_5I + Na\,Sn = C_4H_5Sn + Na\,I.$$

The method I employ for the preparation of the bisulphide of iodine is, in fact, based upon the validity of equation (3). Recompositions quite akin to (3) are undergone by the iodides of methyl and of amyl, whence we may assert the general equation (5)—

$$(5.) \quad C_nH_{n+1}\,I + S_2\,Cl = C_nH_{n+1}\,Cl + S_2I.$$

For obvious reasons, the ethyl compound is preferred.

The reciprocal action of iodide of ethyl and bisulphide of chlorine is perhaps as interesting in its manner as in its result. The two liquids may be mixed in all proportions without a greater change in colour than is due to the dilution of the coloured sulphide by the colourless iodide; neither is heat liberated, nor other immediate token given of chemical change taking place. The change appears to be complete in about twelve hours. If the recomposition vessel be open to the air, the chloride of ethyl evaporates as it is formed, leaving the bisulphide of iodine in magnificent crystals, contaminated, however, by the products of the action of the moisture of the air upon the bisulphide of chlorine. For this reason the process is best conducted in a hermetically sealed tube. The co-reagents are used in the proportion shown by the equation, a very slight excess of the iodide being added.

On opening a tube so charged which has been left overnight, and applying the heat of the hand, the chloride of ethyl escapes. A gentle heat suffices to expel the residual iodide of ethyl, whereupon the bisulphide of iodine is left in the form of fine tabular crystals, of the lustre of iodine and in a state of absolute purity.

Although the exact composition of the substance may be fairly deduced from its synthesis, it was submitted to analysis in the following way:—0·3270 grms. were heated in a combustion-tube with nitrate of potash and carbonate of soda, whereupon the iodine and sulphur were converted respectively into iodide and sulphate of potassium, and estimated in the usual way.

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* Equation (1) expresses only the initial recomposition between chlorine and iodide of ethyl. The ultimate products are I Cl_3, along with hydrochloric acid and chlorine substitution products of C_4H_5Cl.

	Calculated.	Found.
S_2, .	20·13	20·28
I. .	79·87	79.81
	100·0	100·9

Though in this note the recomposition is considered as a means of preparing the compound halogen S_2I, it is perhaps of equal interest as offering a method for obtaining an organic chloride from its iodide,—a problem otherwise difficult and cumbrous in solution, albeit its inverse is easy and of frequent occurrence.

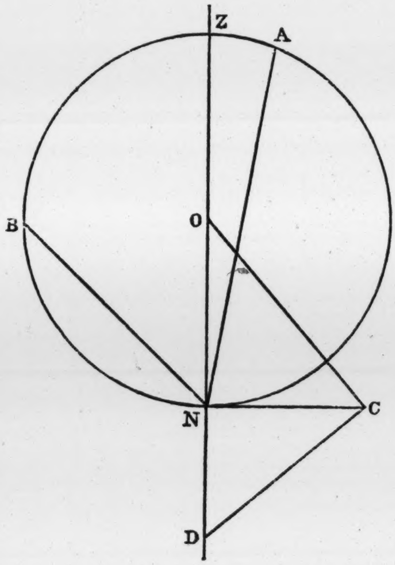
4. Notice of an Expeditious Method (believed to be new) for Computing the Time of Descent in a Circular Arc. By Edward Sang, Esq.

In determining the intensity of gravitation from the oscillations of a pendulum, and in estimating the directive power of the earth's magnetism from the frequency of vibration of a needle, we have to make allowance for the extent of the arc through which the motions take place.

The formula usually given for this purpose contains a series converging rapidly enough for very small arcs, but which requires a great amount of labour when the angle of deflection exceeds twenty or thirty degrees.

My object is to give notice of a process by which the labour becomes insignificant.

Let O be the centre of motion, N the lowest point of the curve, and AN the arc through which the descent is to take place. Having drawn the horizontal tangent NC, make the angle NOC one-fourth part of NOA; through C draw CD perpendicular to OC meeting ON produced in D, and inflect the chord NB equal



to twice ND; then the time of descent in the arc AN is to the time of descent in BN as OD is to ON.

By treating the arc BN in the same way, we can obtain a third arc, and so on, thus forming a series of arcs decreasing more and more rapidly as we proceed.

Let the angle NOA be denoted by $4A_0$, NOB by $4A_1$, the next angle of the series by $4A_2$, and so on; then we have, for any two consecutive terms of the progression,

$$(\tan A_n)^2 = \sin 2A_{n+1}, \qquad \text{and}$$

$$\text{time in } 4A_n = (\sec A_n)^2 \times \text{time in } 4A_{n+1}.$$

Now the time of descent in a small circular arc approaches to the time in a cycloidal one, and hence,

$$\text{time in } 4A_0 = \{\sec A_0 \times \sec A_1 \times \sec A_2 \times \text{etc.}\}^2 \times \text{time in cycloid.}$$

As an example of the ease and rapidity of the calculation, I subjoin the work for an angle of 160° from the nadir line, which shows that the time of oscillation in an arc of 320° is rather more than double of that in a minute arc.

A_n	2 Log sec A_n	2 Log tan A_n	2 A_{n+1}
° ′ ″			° ′ ″
40 00 00·000	·2314920670	9·8476270604	44 45 21·339
22 22 40·669	680053042	9·2292047378	9 45 34·359
4 52 47·180	31540158	7·8626575152	25 03·441
12 31·721	57684	5·1607141918	2·986
1·493	0		
	·3026571554	= log. 2·00750740.	

The progression may be put in another form, thus:—let t_0, t_1, t_2, &c., be the tangents of the angles A_0, A_1, A_2, &c.; then,

$$t_{n+1}{}^2 = \frac{1-\sqrt{(1-t_n{}^4)}}{1+\sqrt{(1-t_n{}^4)}} = \frac{t_n{}^4}{2+2\sqrt{(1-t_n{}^4)}-t_n{}^4}, \text{ the}$$

coefficient of correction being

$$(1+t_0{}^2)\,(1+t_1{}^2)\,(1+t_2{}^2), \text{ \&c.}$$

5. Note on a Modification of the Apparatus employed for one of Ampère's Fundamental Experiments in Electrodynamics. By Professor Tait.

My attention was recalled by Principal Forbes's note (read to the Royal Society on January 7th), to his request that I should at leisure try to repeat Ampère's experiment for the mutual repulsion of two parts of the same straight conductor, by means of an apparatus which he had procured for the Natural Philosophy Collection in the University. Some days later I tried the experiment, but found that, on account of the narrowness of the troughs of mercury, it was impossible to prevent the capillary forces from driving the floating wire to the sides of the vessel. I therefore constructed an apparatus in which the troughs were two inches wide, the arms of the float being also at that distance apart. Making the experiment according to Ampère's method with this arrangement, I found one small Grove's cell sufficient to produce a steady motion of the float from the poles of the pile; in fact, the only difficulty in repeating the experiment lies in obtaining a perfectly clean mercurial surface.

Two objections have been raised against Ampère's interpretation of this experiment, one of which is intimately connected with the subject of Principal Forbes's note. This is the difficulty of ascertaining exactly what takes place where a voltaic current passes from one conducting body to another of different material. It is known that thermal and thermo-electric effects generally accompany such a passage. To get rid of this source of uncertainty, I have repeated Ampère's experiment in a form which excludes it entirely. In this form of the experiment the polar conductors and the float form one continuous metallic mass with the mercury in the troughs; the float being formed of glass tube filled with mercury, with its extremities slightly curved downwards so as nearly to dip under the surface of the fluid; and the wires from the battery being plunged into the upturned outward extremities of two glass tubes, which are pushed through the ends of the troughs so as to project an inch or two inwards under the surface of the mercury. A little practice is requisite to success in filling the float and immersing it in the troughs without admitting a bubble of air. This float, being heavier than the ordinary copper wire, plunges deeper in the fluid, and encounters more resistance to its motion, but, with two small Grove's cells only, Ampère's result was easily reproduced, even when the extremities of the float rested in contact with those of the polar tubes before the circuit was completed. It is obvious that here no thermo-electric effects can be produced in the mercury, and I have satisfied myself that the motion commences before the passage of the current can have sensibly heated the fluid in the tubes.

The other class of objections to Ampère's conclusion from this experiment, depending on the spreading of the current in the mercury of the troughs, is of course not met by this modification. I have made several experiments with a view to obviate this also, but my time has been so much occupied that I have not been able as yet to put them in a form suitable for communication to this Society.

The following Gentleman was admitted as a Fellow:—

James Lorimer, Advocate.

The following Donations to the Library were announced:—

On the Causes of Death in the Scottish Widows' Fund Life Assurance Society, from January 1853 to January 1860. By James Begbie, M.D., F.R.S.E.—*From the Author.*

Proceedings of the Royal Horticultural Society, Nos. VI. XVI., 1860; XXI., 1861.—*From the Society.*

Monthly Notices of Astronomical Society, Vol. XXI., No. 3.—*From the Society.*

Transactions of the Linnean Society, Vol. XXII., Part 4; XXIII., Part 1, 4to.—*From the Society.*